July 1, 1969
see additional info
in letter from Ashing, Mills
Assoc @ end of this rpt

Grading Permit No. 4544
REPORT #327

FOUNDATION INVESTIGATION

2 MILLION GALLON RESERVOIR

BOOSTER PUMP STATION
MAKAHA VALLEY, OAHU

for

CAPITAL INVESTMENT COMPANY

SUNN, LOW, TOM & HARA, INC.
Civil Engineers
Honolulu, Hawaii

PAUL TANIGUCHI
Structural Engineer
Honolulu, Hawaii

by

AHSING, MILLS & ASSOCIATES
Consulting Foundation and Soils Engineers
P. O. Box 206
Aiea, Oahu

AHSING, MILLS and ASSOCIATES, INC.

Francis K. Y. Mau, P.E. – Robert W. H. Ahsing – William K. Mills – Lawrence K. Ahsing

99–110 KAUHALE STREET • P. O. BOX 206 • AIEA, HAWAII 96701 • PHONE 462–400

February 17, 1969

Sunn, Low, Tom & Hara, Inc.
195 South King Street
Honolulu, Hawaii

Gentlemen:

Transmitted herewith is our report on foundation investigation for the 2-Million Gallon Reservoir and for the Booster Pump Station, both for the Makaha Valley Project.

The investigation showed that the loose boulders are underlain by more or less cemented material which will provide suitable foundations.

As pointed out in the report, the original stakes as laid out by the surveyor were disturbed by the bulldozing that was necessary to make the site usable by drilling equipment. We have made allowances for this in our estimate of elevations of the various sub-surface materials. However, if the elevations are critical, accurate levels should be re-run.

Very truly yours,

AHSING, MILLS and ASSOCIATES, INC.

By K. B. Hirashima
K. B. Hirashima, P.E.

KBH:lr

The results of two sub-surface investigations are reported herein.

Part I describes the investigations conducted in connection with the foundations for a 2-million gallon concrete reservoir.

Part II deals with foundation investigation for a booster pump station.

Both projects are in connection with the development of Makaha Valley, Oahu.

PART I

2 MILLION GALLON RESERVOIR

LOCATION OF SITE

The site of the proposed 2-million gallon concrete reservoir is located on a rock talus slope on the west or Kaena side of Makaha Valley about 1-1/2 miles inland from Farrington Highway and at about the 500-foot contour.

FIELD INVESTIGATIONS

The site was in an uncleared and extremely rough area. A crude bulldozer trail was the first order of business so as to make the site accessible to truck-mounted drilling equipment.

A 3-1/2 inch auger rig was used to advance the holes. The sub-surface conditions, as revealed by these borings, are presented in graphic form on Plate B.

The data on Plate B reveal the following -

(a) The top consists of loose boulders ranging in size from 1 foot up.

(b) Below the surface layer of boulders is a conglomerate of the same kind of boulders but somewhat cemented. This continued down the full depth of the borings. The cementation is not uniform but varies. In places the cementation is weak and in others firm.

The materials of the boulders and conglomerate is all basalt rock.

The elevations at which the changes in formation take place are noted on Plate B. However, this is an estimate only, since the original stake and elevation as laid out by the surveyor was disturbed in bulldozing the area.

RECOMMENDATIONS

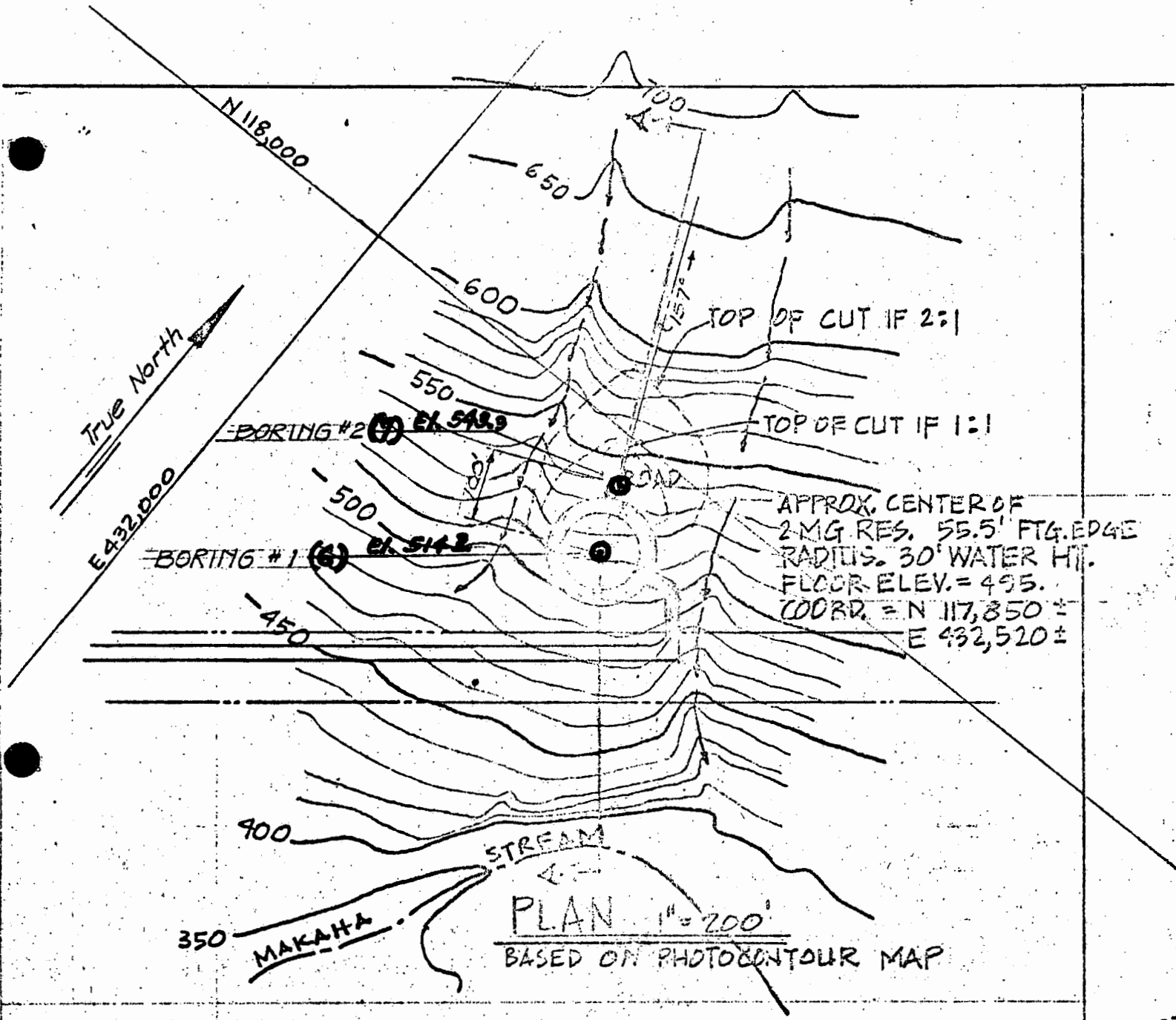
The loose boulders are not a suitable foundation for the proposed reservoir. The underlying conglomerate is a suitable foundation for the reservoir. A bearing value not to exceed 5 tons per sq. ft. is recommended.

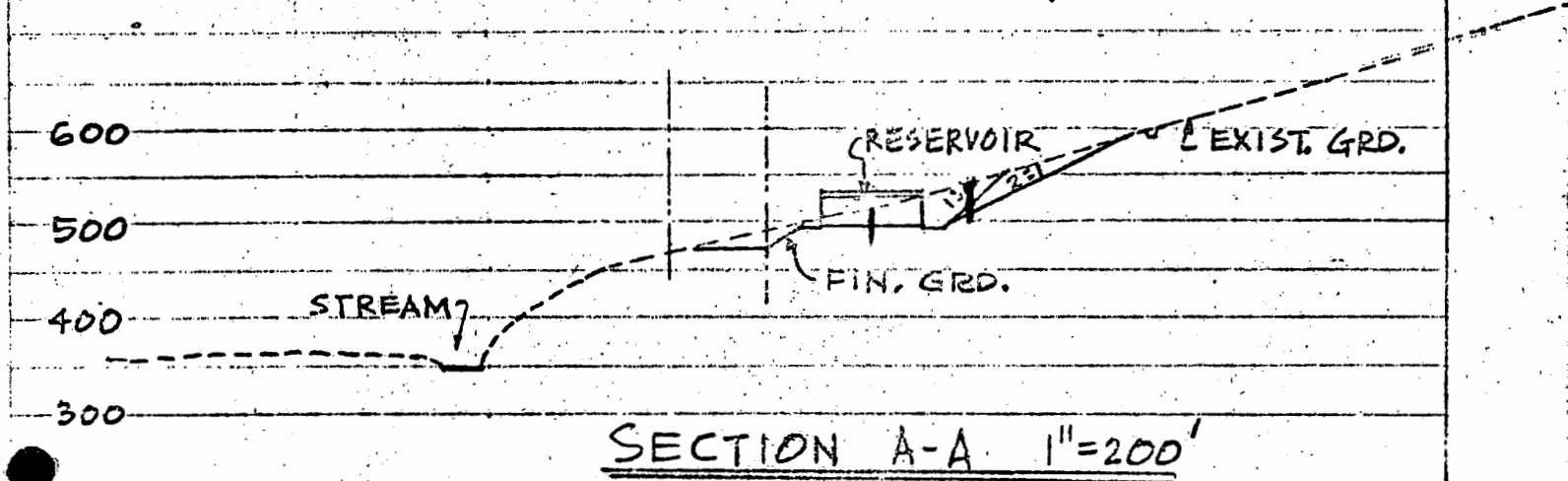
Slopes in loose boulders shall be 2 horizontal to 1 vertical. Large boulders (say over 1 foot in size) should be placed flat and wedged into place for stability and not just bulldozed into place.

Cuts in solid rock can be made as steep as 1/4 to 1.

If the selected elevation of the bottom of foundations is such that they will be partly in conglomerate and partly in loose boulders, if the foundations were all on one plane, then the part in loose boulders should be benched out to the conglomerate below. Or the location moved inward toward and into the hillside, so that the foundations will be all on the conglomerate.

Carry the foundations at least 1 foot into the conglomerate.



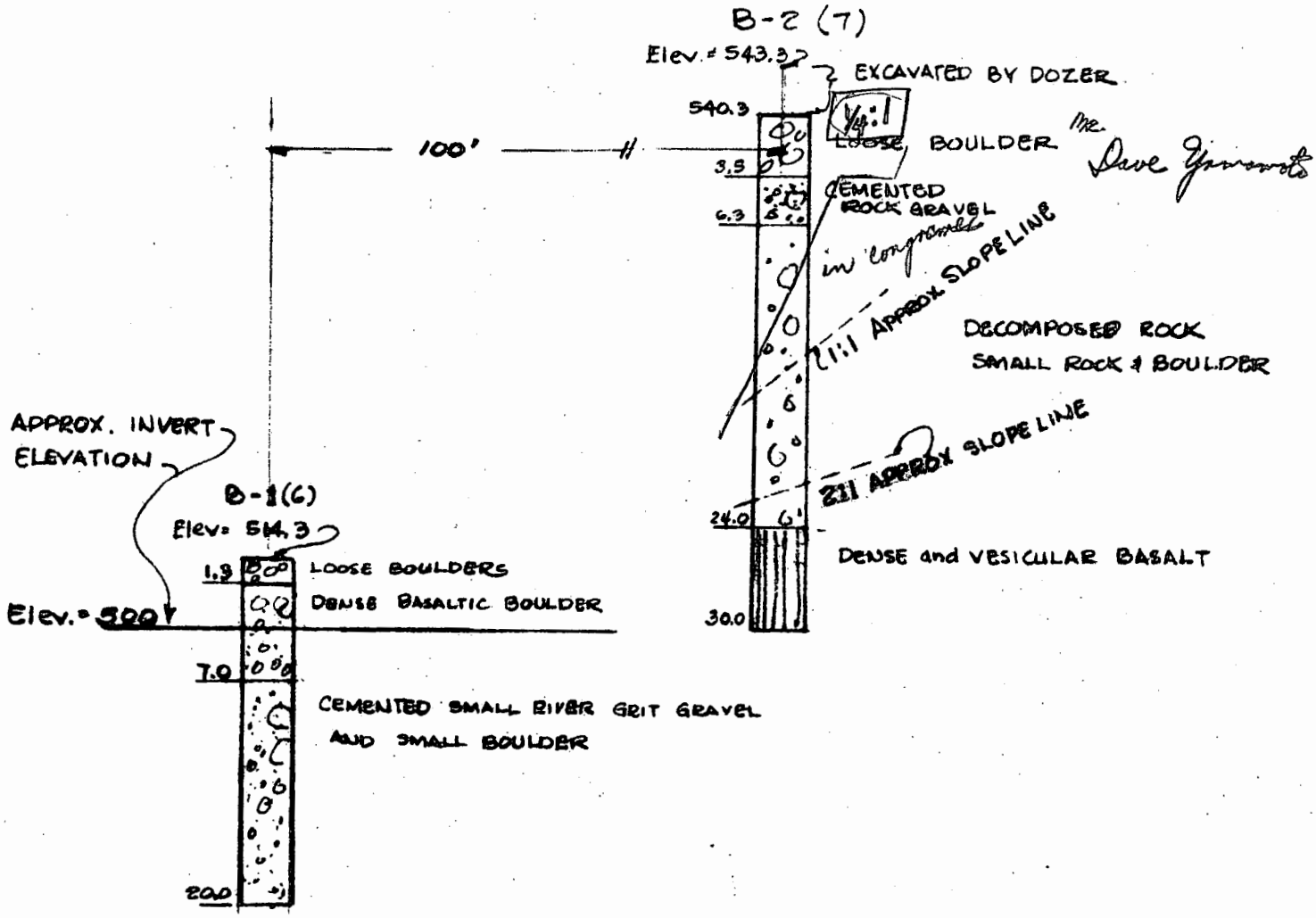


SECTION A-A 1"=200'

AHSING, MILLS and ASSOCIATES, INC.
99-110 KAUHALE ST. BOX 206 AIEA, HAWAII 96701
K.B. HIRASHIMA P.E.

PROJECT: MAKAHA 2.0 M.G. RES.
PHASE: PRE-PRELIMINARY SITE PLAN
SUBJECT: BORING LOCATION

PLATE A



MAKAHA 2.0 M.G RESERVOIR	
K B HIRASHIMA P.E. AHSING, MILLS & ASSOCIATES INC	
BORING LOGS	PLATE B

PART II

BOOSTER PUMP STATION

SITE

The booster pump station is located some distance makai of the reservoir. It is also on a talus slope at about elevation 170 feet.

FIELD INVESTIGATION

The same equipment and methods were used as in the case of the reservoir.

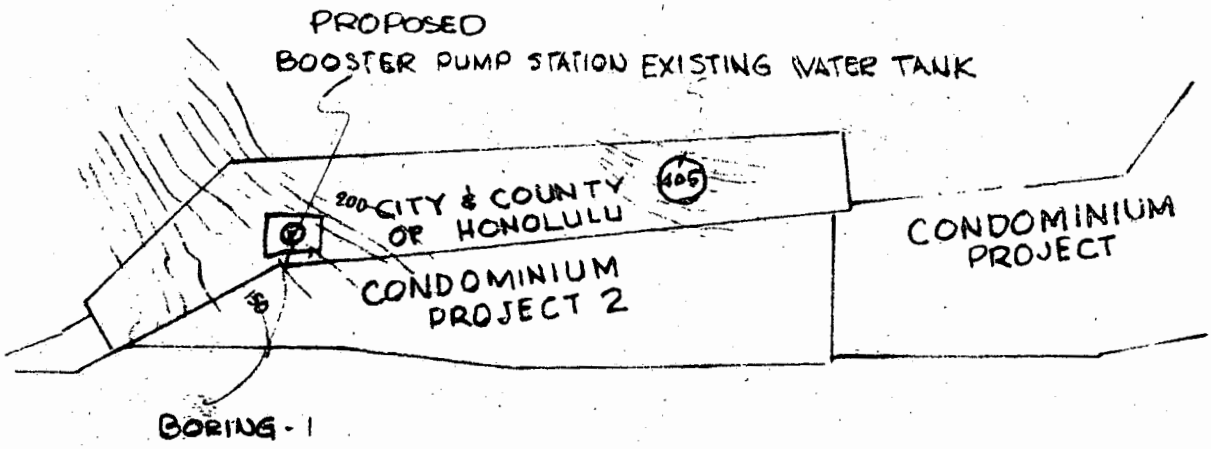
A single boring was made. Its location is as shown on Plate C.

The sub-surface data have been plotted on Plate D. The data are similar to that in the case of the reservoir. A conglomerate layer underlies the loose boulders which here measure from only a foot or so.

Foundations should be carried at least a foot into the conglomerate. A bearing value not to exceed 5 tons per sq. ft. is permissible.

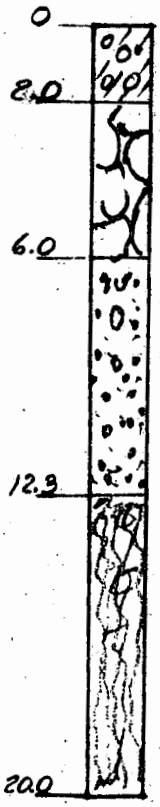
EROSION PROTECTION

Because of the danger of erosion, it is imperative not to disturb the existing vegetation any more than a bare minimum necessary for construction purposes. It is desirable that areas stripped of vegetation be suitably re-planted.



BORING LOCATION
PLATE C

B-1
Elev. 159.0



LOOSE BOULDER WITH STREAK OF ADOBE AND SMALL ROCK

DENSE BASALTIC BOULDERS

CEMENTED SMALL ROCKS GRIT, GRAVEL AND SMALL BOULDERS

MEDIUM HARD PACK DECOMPOSED ROCK

BORING LOG - PLATE - D

BOOSTER PUMP STATION
MAKAHA DEVELOPMENT
K.B. HIRASHIMA P.E.
AHSING, MILLS & ASSOCIATES INC

PLATE NOS. C and D

AHSING, MILLS & ASSOCIATES, INC.
Francis K. Y. Mau, P.E. – Robert W. H. Ahsing – William K. Mills – Lawrence K. Ahsing
99–110 KAUHALE STREET • P. O. BOX 206 • AIEA, HAWAII 96701 • PHONE 462–400

April 23, 1969

Sunn Low Tom & Hara, Inc.
Room 601, 195 South King
Honolulu, Hawaii

Gentlemen:

SUBJECT: Makaha 2.0 M.G. Reservoir

This is in answer to the letter addressed to you from Paul T. Taniguchi dated March 25, 1969 concerning the proposed 2.0 M.G. Reservoir at Makaha. Our answers below are numbered to correspond with the numbers in their letter.

1. Of course what is below the ground cannot be seen; but it is our judgment, based on past experience, that below the top surface of loose boulders the material is more or less cemented. In this sense all the materials named can be considered a conglomerate of some sort.

2. A uniform bearing value of 5 tons per square feet is applicable to all the material below the surface boulders. If pockets of loose materials are found during construction, the foundation must be carried below such loose material.

3. Cut slopes as steep as $\frac{1}{4}$ to 1 are good in the conglomerate as well as the solid rock. Loose pockets should be gunited or pointed up with cement mortar.

4. The layer of loose boulders would not be satisfactory as a pavement subgrade, unless bound with soil or other fine material.

5. Flow velocities comparable to those allowed in solid rock may be allowed in storm ditches cut in the conglomerate

6. If the boulders are wedged in a substantial manner, which means more or less cemented, slopes may be made as steep as $1\frac{1}{2}$ to 1. If the boulders are imbedded simply in soil, the soil will eventually erode away and such slopes, although they may stand up for a long period of time, cannot be considered permanently stable.

We hope the above answers all the questions raised.

Very truly yours,

AHSING, MILLS and ASSOCIATES, INC.

By K. B. Hirashima

K. B. Hirashima

Paul T. Taniguchi, Ltd.
CIVIL ENGINEERS • STRUCTURAL ENGINEERS
1649 KAPIOLANI BOULEVARD • HONOLULU, HAWAII 96814
TELEPHONE 949-5328

March 25, 1969

Sunn, Low, Tom and Hara, Inc.
Room 601, 182 Merchant Street
Honolulu, Hawaii 96813

Gentlemen:

Subject: Makaha 2.0 M.G. Reservoir

The following paragraphs cover some information and recommendations obtained through telephone by the undersigned from Mr. Ahsing and Mr. Hirashima of Ahsing, Mills and Associates regarding their Foundation Investigation Report dated February 17, 1969 for the subject project. We would appreciate their confirmation in writing.

1. "Conglomerate" includes "dense basaltic boulder", "cemented small river grit gravel", "cemented rock gravel", "decomposed rock, small rock and boulder", "medium hard packed decomposed rock" and all other materials shown in the boring logs, excluding the layers labeled "loose boulder" or "loose boulders".

2. A maximum bearing value of 5 tons per sq. ft. would be good in all of these materials of the conglomerate.

3. Cut slopes as steep as 1/4 to 1 are good in the conglomerate as well as in solid rock.

4. The layer of loose boulders would not be satisfactory as a pavement subgrade, unless bound with dirt or other fine material.

5. Flow velocities as high as those allowed in solid rock may be allowed in unlined storm drainage ditches cut in the conglomerate.

6. Slopes in loose boulders may be made as steep as 1-1/2 to 1, provided the boulders are wedged in place.

Very truly yours,

PAUL T. TANIGUCHI, LTD.

By David M. Yamamoto
David M. Yamamoto

Bert Hirashima's copy

Feb 26, 1970

Mr. H. J. Young 4-047

Attached is a copy of soils rept & prints of grading prints for Makaha valley water resprvoir per your discussion w Mr. James Hara.

Geary Asato

PW-DE-40
2/69

CITY AND COUNTY OF HONOLULU
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING

DATE _____ 19__

FROM: H. J. Young

TO:

- ☐ YOUNG, H. J.
- ☑ LING, W.
- ☐ CHUN, RAY
- ☐ KIDO, K.
- ☐ MURAKAMI, T.
- ☑ NAKAGAWA, H.
- ☐ NISHIZAWA, R.
- ☐ PAHK, C.
- ☐ TAKAMATSU, D.
- ☐ TOKUSHIGE, W.
- ☐ INVESTIGATOR
- ☐ SECRETARY
- ☐ _____
- ☐ _____

FOR:

- ☑ APPROPRIATE ATTENTION AND ACTION
- ☐ DRAFT REPLY
- ☐ COMMENTS & RECOMMENDATIONS
- ☐ SEE ME
- ☐ WORK ORDER
- ☐ ARRANGE MEETING
- ☐ SIGNATURE
- ☐ INFORMATION
- ☐ FILE
- ☐ _____

LOG. NO. _____ SUSPENSE _____

MAIN OFFICE
1139 WILSHIRE BLVD., LOS ANGELES 90017 • 213 • 481-3990
[illegible] LONGER STREET, SANTA ANA, CALIFORNIA 92705 • (714) [illegible]
740 EAST THOMPSON BLVD., VENTURA, CALIFORNIA 93001 • (805) 643-3435
92-901 FARRINGTON HIGHWAY, WAIPAHU, HAWAII 96797 • (808) XXXXXX 677-0345

MAURSETH · HOWE · LOCKWOOD & ASSOCIATES
A CORPORATION
Consulting Foundation Engineers and Geologists

RAY O. MAURSETH, C.E.
JOHN B. HOWE, C.E.
ROBERT D. COUSINEAU
CHARLES S. HOWE JR., C.E.
R. BRUCE LOCKWOOD, GEOL.-P.E.

Honolulu, Hawaii
February 17, 1970

Project No. H-62

Makaha Valley, Inc.
% Ilikai Hotel
1777 Ala Moana Blvd.
Honolulu, Hawaii 96815

Attention: Mr. George Lum

Gentlemen:

Report of a Soils Investigation
Proposed 2.0 Million Gallon Reservoir
Makaha Valley, Oahu, State of Hawaii

For Makaha Valley, Incorporated

INTRODUCTION

Presented herewith is the results of a subsurface investigation for the proposed 2.0 Million Gallon Reservoir to be located in Makaha Valley, Oahu, State of Hawaii. During the course of the investigation, results were transmitted to Mr. James Hara of Sunn, Low, Tom and Hara.

Four borings were drilled on the site. The boring locations are shown on the Plot Plan, Plate 1, attached to this report.

OFFICE COPY
Feb 26, 1970

RESULTS

The four borings were drilled to depths ranging between 10 and 35 feet below existing grade. A detailed description of the materials encountered are presented on Plates 2 through 4, Log of Borings.

The soils, which remained relatively consistant in all borings were a portion of the Talus Deposit which covers the near surface of the lower valley slopes. The deposit is generally a mixture of boulders, cobbles and gravel with a matrix of silt, sand and clay. The matrix material was stiff, but would deteriorate in a slope when exposed.

Visual inspection of the cut slopes indicated zones within the Talus Deposit which were cemented, and zones which contained little to no matrix of silt and clay. A description of the exposed soils and their characteristics is presented in a previous report on "Excavation Inspection", dated February 9, 1970.

CONCLUSIONS

No continuous layer of cemented material was encountered in the borings. The quality of the soils is different from those anticipated, and upon which design of the reservoir was based.

Foundations

Design of the tank foundations is for a bearing pressure of 5,000 pounds per square foot. Based on this investigation and the previous construction inspection, it is believed that this allowable bearing capacity is acceptable.

Slopes

It is recommended that the slopes be cut on a 2 to 1 (horizontal to vertical) in the upper, loose gravel and silty clay zones. This will be, as previously planned, in the upper 6 to 7 feet of the slope.

Within the Talus Deposit, it is recommended that the slopes be cut on a 1 to 1 for heights not exceeding 20 feet. If the slope is higher than 20 feet, a 5 foot wide bench should be installed, followed by another section of slope on a 1 to 1, 20 feet in height.

Basically, this follows the recommendations presented in the report of February 9, 1970. It should be noted that, even with the flatter slopes, some of the boulders will loosen from the slope face with time. Under the normal weathering process, the matrix will be removed from around the rocks. This, however, cannot be economically prevented and should be considered as a maintainence problem.

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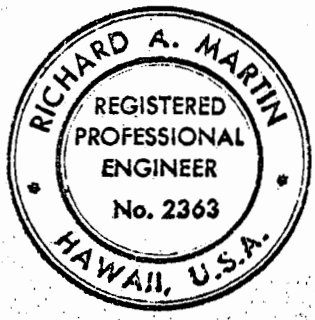
If there are any questions concerning this report, please do not hesitate to contact us.



Very truly yours

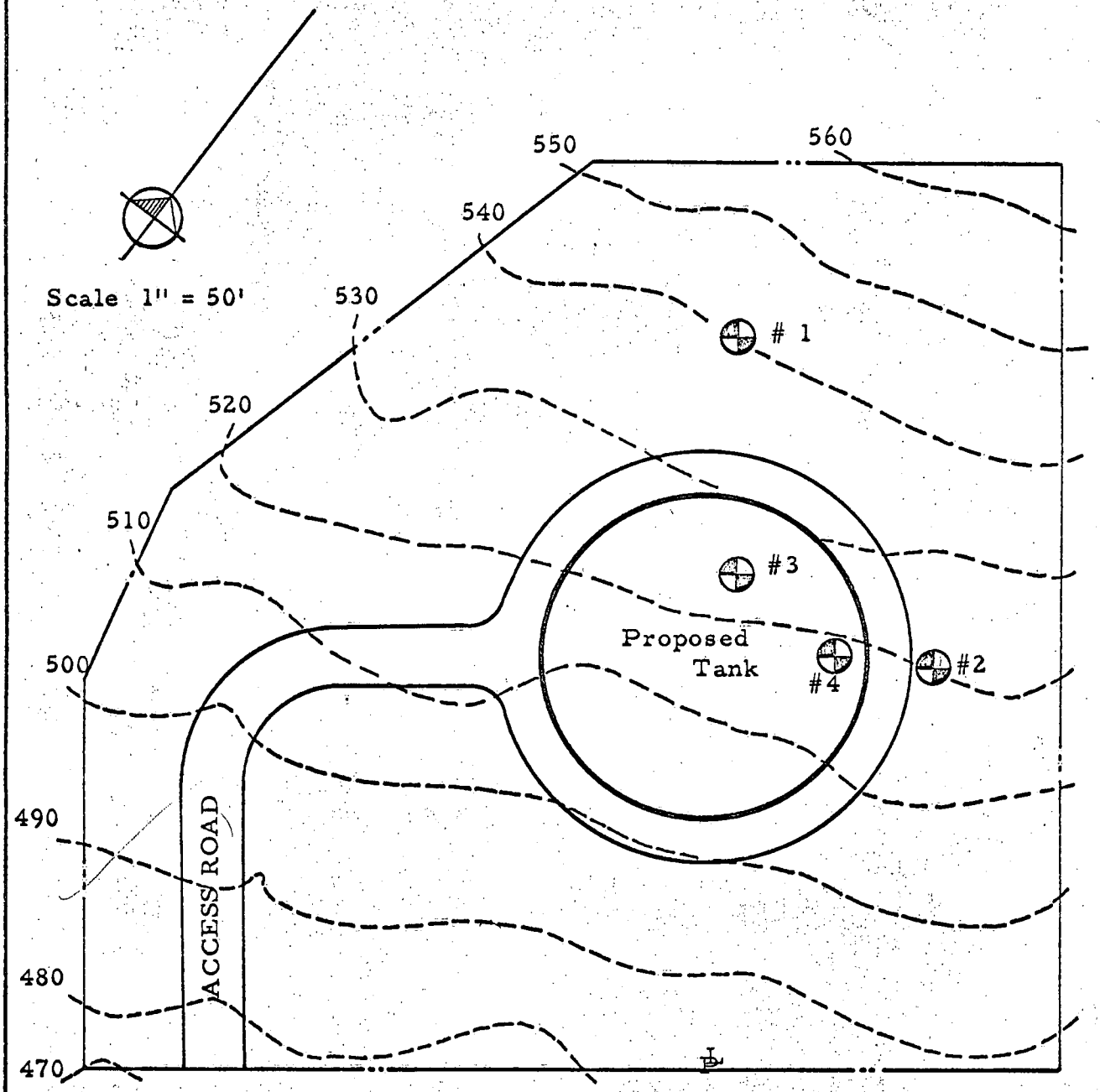
MAURSETH, HOWE, LOCKWOOD & ASSOCIATES

Richard A. Martin

Richard A. Martin

RAM/rg

cc: Sunn, Low, Tom and Hara



PLOT PLAN

LEGEND

Boring Locations

Original Contours

PROPOSED 2,000,000 GALLON RESERVOIR
FOR MAKAHA VALLEY

MAURSETH, HOWE, LOCKWOOD
& ASSOCIATES

Plate I
File No. H-62

LOG OF BORING NO 1

DATE DRILLED: February 11 & 12, 1970

EQUIPMENT USED: Truck Mounted Auger 3.5" Dia

ELEV. OF SURFACE: 527.2

Depth in Feet	Samples	Blows Per Foot	DESCRIPTION OF SOILS — CLASSIFICATION	Color	Moisture	Consistency	Dry Unit Weight lb. per cu. ft.	COHESION ○ OR SHEAR RES. ○ KIPS PER SQUARE FOOT (1 2 3 4 5) MOISTURE PERCENT DRY/WT. (▲ 10 20 30 40 50)
5		8 1/2"	TALUS deposit CLAY, silty with a large amount of gravels, cobbles and boulders to 4' visible	dark yellow brown gray & brown mott.	sl moist	stiff		
10			With partly cemented streaks.					
15		20/3"						
20		50/5"						
25		70/6"						
30								
35		14-6" 60-3"	End of Boring @ 35'					

Standard Pentration 140 Hammer @ 30" drop

PROPOSED MAKAHA VALLEY 2,000,000 GALLON RESERVOIR

PLATE NO. II

MAURSETH HOWE LOCKWOOD & ASSOCIATES

FILE NO. H-62

LOG OF BORING NO 2

DATE DRILLED: February 12, 1970

EQUIPMENT USED: Truck Mounted Auger 3.5" Dia

ELEV. OF SURFACE: 512.0

Depth in Feet	Samples / Blows Per Foot	DESCRIPTION OF SOILS — CLASSIFICATION	Color	Moisture	Consistency	Dry Unit Weight lb. per cu. ft.
0		TALUS deposit CLAY, silty with a large amount of gravels cobbles and boulders to 4' visible	dark yellow brown gray & brown mott.	sl moist	stiff	
5	25/2"	With partly cemented streaks				
10	20/2"					
15	20/5"					
20		End of Boring @ 18.2'				

COHESION ○ OR SHEAR RES. ○ KIPS PER SQUARE FOOT

1 2 3 4 5

MOISTURE - PERCENT DRY/WT.

▲ 10 20 30 40 50

PROPOSED MAKAHA VALLEY 2,000,000 GALLON RESERVOIR

MAURSETH HOWE LOCKWOOD & ASSOCIATES

PLATE NO. III

FILE NO. H-62

LOG OF BORING NO 3

DATE DRILLED: February 13, 1970
EQUIPMENT USED: Trunk Mounted Auger 3.5" Dia
ELEV. OF SURFACE: 504.2

Depth in Feet	Samples	Blows Per Foot	DESCRIPTION OF SOILS — CLASSIFICATION	Color	Moisture	Consistency	Dry Unit Weight lb. per cu. ft.
5			TALUS deposit CLAY, silty with a large amount of gravels, cobbles and boulders to 4' visible with partly cemented streaks	dark yellow brown gray & brown mott.	sl moist	stiff	
10			End of Boring @ 10'				

BORING NO. 4

5			TALUS deposit CLAY, silty with a large amount of gravels, cobbles and boulders to 4' visible. with partly cemented streaks.				
10		25/4"	End of Boring @ 10'				

COHESION ○ OR SHEAR RES. ○ KIPS PER SQUARE FOOT
1 2 3 4 5
MOISTURE PERCENT DRY/WT.
▲ 10 20 30 40 50

PROPSED MAKAHA VALLEY 2,000,000 GALLON RESERVOIR — PLATE NO. IV
MAURSETH HOWE LOCKWOOD & ASSOCIATES — FILE NO. H-62